

CALIFORNIA ENERGY COMMISSION

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DATE: September 13, 2006

TO: Interested Parties

FROM: Connie Bruins, Compliance Project Manager

SUBJECT: Midway Sunset Cogeneration Project (85-AFC-3C)
Staff Analysis of Proposed Modifications to Install A New Evolution
Compressor Rotor in the Unit A Turbine

On July 26, 2006, the California Energy Commission received a petition from the Midway Sunset Cogeneration Company (MSCC), to amend the Energy Commission Decision for the Midway Sunset Cogeneration Project.

The Midway Sunset Cogeneration Project is a 225 MW cogeneration power plant located near the community of Fellows in Kern County. The project was certified by the Energy Commission on May 14, 1987 and began commercial operation on May 1, 1989. The project uses cogeneration steam to aid in the enhanced oil recovery process.

The proposed modifications will allow MSCC to install a new evolution compressor rotor in the Unit A turbine. The addition of the more energy efficient rotor would increase output by 9 percent (approximately 7 megawatts), lower the heat rate, and reduce emission limits for Oxides of Nitrogen (NOx) and Carbon Monoxide (CO).

Energy Commission staff reviewed the petition and assessed the impacts of this proposal on environmental quality, public health and safety, and proposes revisions to existing condition of certification for Air Quality-18. It is staff's opinion that, with the implementation of the revised condition, the project will remain in compliance with applicable laws, ordinances, regulations, and standards, and the proposed modifications will not result in a significant adverse direct or cumulative impact to the environment (Title 20, California Code of Regulations, Section 1769).

The amendment petition has been posted on the Energy Commission's webpage at www.energy.ca.gov/sitingcases. Staff's analyses are enclosed for your information and review. Staff's analyses and the order (if the amendment is approved) will also be posted on the webpage. Energy Commission staff intends to recommend approval of the petition at the October 25, 2006, Business Meeting of the Energy Commission. If you have comments on this proposed modification, please submit them to me at the address below prior to October 25, 2006.

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Comments may be submitted by fax to (916) 654-3882, or by e-mail to cbruins@energy.state.ca.us. If you have any questions, please contact me at (916) 654-4545.

Enclosures:

Air Quality Analysis
Efficiency and Reliability Analysis

**REQUEST TO AMEND CONDITION OF CERTIFICATION AIR QUALITY-18 (AQ-18)
MIDWAY-SUNSET COGENERATION POWER PROJECT (85-AFC-3C)**

**Joseph M. Loyer
September 7, 2006**

Amendment Request

The Midway-Sunset Cogeneration Company (MSCC) has submitted a petition to amend Condition of Certification AQ-18 for the Midway-Sunset Cogeneration Power Plant (MSPP) to reflect the addition of a new compressor (the Evolution Rotor) from General Electric. The Evolution Rotor is expected to increase output by 9 percent (from 75 to 82 MW) and decrease the thermal heat rate by 1½ percent, resulting in lower emissions of oxides of nitrogen (NOx) and carbon monoxide (CO) per MW of electricity produced.

Background

The MSPP is a 225 megawatt (MW) cogeneration power plant located near the community of Fellows on the western side of Kern County in the San Joaquin Valley within the North Midway Sunset oil field. MSPP includes three turbine trains each consisting of a GE Frame 7E gas turbine, dry-low NOx combustors (DLN), and an unfired heat recovery steam generator. MSPP has been base loaded (operating at the maximum available level for the maximum available time) providing steam and power to the Midway Sunset oil field thermally enhanced oil recovery (TEOR) activities since May of 1989.

The original license established hourly emission limits assuming that MSPP would use water-injected Quiet Combustors, but was amended to allow for the installation of first DLN-15 Combustors and subsequently DLN-9 Combustors and most recently ammonia-injected Selective Catalytic Reduction (SCR) over a period of years during the normal major overhaul schedule for the project. MSCC would typically take one unit off-line, install the new equipment, as well as perform other necessary maintenance, and restart the unit. This would allow MSCC to investigate any anomalies that had occurred and thus better prepare for the installation of equipment on the other turbines. This method of installing one unit at a time has enabled MSCC to test the new equipment while continuing to supply the oil field with steam without the need to increase the operation of steam field generators, which typically have higher emissions.

The current petition is proposed by MSCC in response to the needs of continuing maintenance, the availability of the new compressor and the major overhaul schedule. The compressors of the GE Frame 7E have an expected operating life of 200,000 hours. However, these compressors have been known to fail prematurely. The compressor of Unit A has approximately 150,000 hours of operation and the major overhaul is scheduled for March of 2007.

The installation of the Evolution Rotor will require a new bell mouth, compressor casing, new rotor and stator blades. However, the foundation and anchorage will not be modified, therefore, construction emissions and impacts will be minimal. The Evolution Rotor is undergoing its initial runs in the GE testing facility. MSPP will install serial number 1 for this type of rotor.

Laws, Ordinances, Regulations and Standards

No laws, ordinances, regulations or standards will be affected by the petitioned amendment requests.

Analysis

With the installation of the Evolution Rotor, MSCC believes they can achieve an emission reduction from 5 to 2 ppm for NO_x and from 25 to 6 ppm for CO (corrected to 15 percent O₂). The current BACT level (best available control technology for new turbines) is 2.0 ppm for NO_x and 6.0 ppm for CO. Condition of Certification AQ-18 establishes the hourly emission limits for the MSPP. MSCC proposes to change those limits as shown in Air Quality Table 1.

**Air Quality Table 1
Proposed Changes to the Hourly Emissions
(pounds per hour)**

	Current Limit	Proposed Limit
Particulates (PM ₁₀)	9.98	9.98
Sulfur Compounds (SO)	0.92	0.92
Oxides of Nitrogen (NO _x)	18.04	7.06 under steady-state operating conditions, or 17.66 without the Evolution Rotor installed
Hydrocarbons (HC)	9.00	9.00
Carbon Monoxide (CO)	54.91	13.18

The current hourly emission limit for NO_x in AQ-18 is 18.04 lbs/hr and is the result of the installation of ammonia injected SCR. After the SCR was installed and tested, the District lowered the limit slightly to 17.66 lbs/hr based on the actual operation of the SCR and its effects on volumetric exhaust flow. MSCC chose to delay this minor revision, with the Commission's permission, until this time. The emission limit of 17.66 lbs/hr shall apply to those turbines without the Evolution Rotor installed.

With the installation of the Evolution Rotor into the Unit A turbine train at MSPP, MSCC believes that Unit A can achieve the emission limit proposed (7.06 lbs/hr) in Air Quality Table 1 under steady-state operating conditions. However, if the unit experiences rapid changing loads, it is possible that the unit will exceed this limit. The MSPP is a base-loaded power plant, and thus should not have a significant number of rapid load changes. However, MSCC would like to avoid any possible consistent operating conditions that might cause MSPP to exceed its emission limits. Since this particular operating condition is not avoidable, MSCC is proposing to add the following excursion language to the 7.06 lbs/hr NO_x emission limit.

Compliance with the NO_x emission limitations during steady-state operation shall not be required during short-term excursions limited to a cumulative total of 10 hours per rolling 12-month period.

Short-term excursions are defined as 15-minute periods designated by the owner/operator (and approved by the CPM) that are the direct result of transient load conditions, not to exceed four consecutive 15-minute periods when the 15-minute average NO_x concentration exceeds 2.0 ppmvd @ 15 percent O₂. The maximum

three-hour average NOX concentration for periods that include short-term excursions shall not exceed 5 ppmvd @ 15 percent O2. The maximum three-hour CO concentration for periods that include short-term excursions shall not exceed 25 ppmvd @ 15 percent O2.

Examples of transient load conditions include, but are not limited to the following: initiation or shutdown of combustion turbine inlet air cooling, or rapid combustion turbine load changes. All emissions during short-term excursions shall accrue towards the daily and annual emissions limitations of this permit and shall be included in all calculations of daily and annual mass emission rates as required by this permit.

This excursion language is similar to other combustion turbine power projects within the San Joaquin Valley and elsewhere. Given the operational history of the MSPP, staff is confident that the MSCC will make little use of this provision, but that they may need this exclusion on rare circumstances.

The only concern staff has is in regards to the ultimate emission limit prescribed for the NOx excursions of 5 ppmvd @ 15 percent O2 (approximately 17.65 lbs/hr). Therefore staff performed a simple modeling analysis using the U.S. Environmental Protection Agency regulatory model SCREEN3. With the information provided to staff via the annual source testing (MSCC 2006a) and quarterly emission reports from MSCC (MSCC 2006b), staff was able to determine that the project would have no more than a 2.49 ug/m³ NO₂ impact from the emission of 106 lbs/hr. Given that the most recent highest background measurement of NO₂ (taken in Oildale in 2003) was 159.8 ug/m³, staff is confident that the impacts from the potential emission of 17.65 lbs/hr will not cause a new violation of the one hour California ambient air quality standard (470 ug/m³). Table Air Quality 2 shows the modeling assumptions and results. The modeling analysis performed shows that there is no significant air quality impact expected from the short-term emission of 17.65 lbs/hr from a single unit at the MSPP facility.

**Air Quality Table 2
SCREEN3 Modeling Results of Excursion Emission Limit**

Modeling Inputs	
Emission Rate ¹	2.22 g/s
Stack Height ²	18.29 meters
Stack Diameter ²	1.54 meters
Stack Gas Flow Rate ²	515,000 scf/min
Stack Gas Temperature ³	444.27 °K
Ambient Temperature	293.16 °K
Receptor Height	6 meters
Urban/Rural option	Rural

Modeling Results				
Predicted Maximum Impact (ug/m ³)	Measured Background (ug/m ³)	Total predicted Impact (ug/m ³)	Ca. Short-term Ambient Air Quality Standard for NO ² (ug/m ³)	Percent of Standard
2.49	159.8	162.29	470	34 percent

Notes: 1) calculated from 5 ppmvd @ 15 percent O₂, 2) MSCC 2006a, 3) MSCC 2006b

Conclusions and Recommendations

Staff has analyzed the proposed changes and concludes that there are no new or additional significant impacts associated with approval of the petition. Staff concludes that the proposed changes are based on information that was not available during the original licensing procedures. Staff concludes that the proposed language retains the intent of the original Commission Decision and Conditions of Certification. Staff recommends the following modifications to Condition of Certification AQ-18.

Proposed Modifications to the Air Quality Condition of Certification

The following Condition of Certification has either added language or modifications to the original condition. New language is underlined and deleted language is in strikethrough.

AQ-18 ~~Pollutant emissions from each DLN-9 dry low NO_x combustion turbine without SCR controls shall not exceed the following limits (in pounds mass per hour, lbm/hr) except during times of start-up or shutdown (as described in Condition of Certification AQ-44):~~

Gas-Fired Case:

Particulate	9.98	lbm/hr
Sulfur Compounds	0.92	lbm/hr as SO ₂
Oxides of Nitrogen	36.08	lbm/hr as NO ₂
Hydrocarbons (nonmethane)	9.00	lbm/hr
Carbon Monoxide	54.91	lbm/hr

Pollutant emissions from each SCR-controlled combustion turbine shall not exceed the following limits (in pounds mass per hour, lbm/hr) except during times of start-up or shutdown (as described in Condition of Certification AQ-44):

Gas-Fired Case:

Particulate	9.98	lbm/hr
Sulfur Compounds	0.92	lbm/hr as SO ₂
Oxides of Nitrogen	48.04	lbm/hr as NO ₂
	<u>17.66</u>	
Hydrocarbons (nonmethane)	9.00	lbm/hr
Carbon Monoxide	54.91	lbm/hr

Pollutant emissions from each combustion turbine with the Evolution Rotor installed, shall not exceed the following limits (in pounds mass per hour) with the exceptions given below.

Gas-Fired Case:

<u>Particulate</u>	<u>9.98</u>	<u>lbm/hr</u>
<u>Sulfur Compounds</u>	<u>0.92</u>	<u>lbm/hr as SO₂</u>
<u>Oxides of Nitrogen</u>	<u>7.06</u>	<u>lbm/hr as NO₂</u>
<u>Hydrocarbons (nonmethane)</u>	<u>9.00</u>	<u>lbm/hr</u>
<u>Carbon Monoxide</u>	<u>13.18</u>	<u>lbm/hr</u>

1. NOx emission concentrations during steady state operation shall not exceed 7.06 lbs/hr over a one-hour average (clock-hour basis). Steady state operation refers to any period that is not a startup or shutdown (as described in Condition of Certification AQ-44). A clock hour in a one-hour average will commence at the top of the hour.
2. Compliance with the NOx emission limitations during steady-state operation shall not be required during short-term excursions limited to a cumulative total of 10 hours per rolling 12-month period.
3. Short-term excursions are defined as 15-minute periods designated by the owner/operator (and approved by the CPM) that are the direct result of transient load conditions, not to exceed four consecutive 15-minute periods when the 15-minute average NOX concentration exceeds 2.0 ppmvd @ 15 percent O2. The maximum three-hour average NOx concentration for periods that include short-term excursions shall not exceed 5 ppmvd @ 15 percent O2. The maximum three-hour CO concentration for periods that include short-term excursions shall not exceed 25 ppmvd @ 15 percent O2.
3. Examples of transient load conditions include, but are not limited to the following: initiation or shutdown of combustion turbine inlet air cooling, or rapid combustion turbine load changes. All emissions during short-term excursions shall accrue towards the daily and annual emissions limitations of this permit and shall be included in all calculations of daily and annual mass emission rates as required by this permit.
4. All emissions during short-term excursions shall accrue towards the hourly, daily and annual emissions limitations of these conditions and shall be included in all calculations of hourly, daily, and annual mass emission rates as required herein.

Verification: ~~The combustion turbines identified as Units A and B shall have completed the installation and testing of the SCR system no later than April 30, 2004. The combustion turbine identified as Unit C shall have completed the installation and testing of SCR system no later than April 30, 2005.~~

To demonstrate compliance with the emission limits provided, the owner/operator shall provide initial and on-going performance tests as follows:

- a. At least 60 days before commercial operation date of the power cogeneration facility, or 60 days before the permit to operate anniversary date, the owners shall submit to the SJVUAPCD, CARB and the CEC a detailed performance test plan for the power plant's AECS. The performance test will be funded by the owners and conducted by a third party approved by the SJVUAPCD and CARB. The SJVUAPCD will notify the owners and the CEC of its approval, disapproval, or proposed modifications to the plan within 30 days of receipt of the plan. The owners

- shall incorporate the SJVUAPCD and the Commission's comments or modifications to the plan.
- b. The owners shall notify the SJVUAPCD and the CEC, within five days, before the facility begins commercial operation. The owners shall also notify the SJVUAPCD one week prior to the beginning of testing to allow the SJVUAPCD to observe and/or conduct concurrent sampling.
 - c. Compliance with emission limits shall be demonstrated by a SJVUAPCD witnessed sample collection performed by an independent testing laboratory within 60 days after startup of this equipment and annually within 60 days prior to permit anniversary date.
 - d. The owners shall submit the results of the compliance test within 30 days of completion of the tests. The owners shall submit to the SJVUAPCD, its application for a Permit to Operate via registered mail. The owners shall submit a copy of the application to the CEC within 10 days of its submittal to the SJVUAPCD. The SJVUAPCD shall approve or disapprove the application as prescribed in the SJVUAPCD rules.
 - e. The owners shall include all Excursions in the Quarterly Emissions Report as a separate section (such as "breakdowns" or "excess emissions") as well as including them in all daily and annual emission calculations.

References

Midway-Sunset Cogeneration Company (MSCC) 2006a. Source Test Report for Annual Compliance and Relative Accuracy Testing of Three GE Frame 7E Natural Gas Fired Turbine. Dated May 18, 2006.

MSCC 2006b. Midway-sunset Cogeneration Company, Second Quarter Air Quality Report. Submitted July 28, 2006.

**PETITION TO INSTALL EVOLUTION ROTOR IN UNIT A GAS TURBINE
EFFICIENCY AND RELIABILITY ANALYSIS
MIDWAY SUNSET COGENERATION PROJECT (85-AFC-3C)**

**Steve Baker
September 7, 2006**

Request

Midway Sunset Cogeneration Company requests Energy Commission approval to replace the compressor of the Unit A gas turbine with a new Evolution rotor.

Laws, Ordinances, Regulations and Standards (LORS)

Federal and state laws set minimum operating and efficiency standards for cogeneration power plants. The salient laws are 18 CFR 292.205 (federal) and PRC § 25134(a) (state). There are no LORS pertaining to reliability.

Analysis

Efficiency: General Electric (GE), manufacturer of the Frame 7E gas turbine generator that powers Unit A, continually strives to improve and upgrade their hardware offerings. As GE gains experience with a machine, and as design techniques improve with time and technological advancements, the company offers upgraded components to owners of their products. GE has recently completed testing of a newly redesigned compressor for the Frame 7E machines that increases the machine's maximum power output by 9 percent while increasing its fuel efficiency by 1½ percent. Midway has shown itself able to market the power from this plant; a 9 percent increase in available power increases potential revenues from the project a like amount. Since fuel purchases typically account for over two-thirds of the cost of operating a fossil-fueled power plant, any power plant owner is motivated to consider adopting improvements that can increase fuel efficiency. Installation of the Evolution rotor will not jeopardize the unit's ability to comply with the cogeneration efficiency standards.

Reliability: The compressor blades and vanes of a gas turbine see harsh service; they will eventually fail if not repaired or replaced. GE Frame 7E gas turbines commonly operate for 200,000 hours before compressor parts must be changed, but some machines have failed before this milestone. Midway's Unit A has seen nearly 150,000 operating hours; its compressor components would soon be candidates for replacement even were it not for the performance advancements offered by the Evolution rotor. Replacing the rotor at this time will enhance the reliability of Unit A.

Mitigation Measures and Conditions

Efficiency: Two Efficiency conditions of certification are included in the Commission Decision. They require that the project be operated in compliance with federal and state efficiency standards for a cogeneration power plant, and that the plant not be modified without Energy Commission concurrence if the modification could jeopardize compliance with the efficiency standards. Neither of these conditions would be violated

by replacing the Unit A compressor with an Evolution rotor. In fact, the increased fuel efficiency of the modified machine would likely increase the margin by which it exceeds the standards. No mitigation measures are required.

Reliability: Six Reliability conditions of certification are included in the Commission Decision. Condition 1 requires the project owner to inform the Energy Commission of any design changes that could affect the project availability or capacity factors. By submitting this Amendment Petition, Midway has complied with this condition.

Condition 3 requires the project owner to submit to the Energy Commission an annual report of reliability-related operating information. Installation of the Evolution rotor will not hamper Midway's ability to continue to comply with this condition.

The remaining Reliability conditions of certification are unaffected by this petition. No further mitigation measures are required.

Conclusions

From the standpoint of Efficiency and Reliability, staff recommends that this petition be approved. Installation of the Evolution compressor rotor will enhance both fuel efficiency and reliability of Unit A. This recommendation is based on the following conclusions:

1. There will be no new or additional significant environmental impacts associated with this action. Both efficiency and reliability will be improved over current levels.
2. The proposed modification retains the intent of the original Energy Commission Decision and conditions of certification.
3. The amendment is based on new information that was not available during the licensing proceedings.